

PATENT APPLICATION

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MULTIPLE PARALLEL LAYER FILTER AND FILTRATION METHOD

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This application is filed within one year of, and claims priority to Provisional Application Serial Number 60/526,889, filed 12/4/2003.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to fluid filtration systems and, more specifically, to a Multiple Parallel Layer Filter and Filtration Method

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2. Description of Related Art

Filters of many designs and configurations have been used in many fields, and for filtering many fluids, including air, oil, water and many others. Whatever the type of conventional filter, it is normal that they be configured in different filtration sizes in order to obtain different results (and to be used with different fluid viscosities), ranging from nano- and micro- to macro-filtration. As filters begin to trap more and more material, they begin to clog and create a pressure drop as well as to block fluid flow. At some point, just about every type of filter element must be replaced due to this fouling.

There is thus a widely held need to avoid this fouling problem because of the efficiency reductions of the system, as well as to avoid unnecessary replacement costs for new filters.

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What is needed, then, is a fluid filtration system and method in which the filtration size is adjustable in order to enable the user to vary the size of the suspended solids being trapped therein. Furthermore, a system that permits cleaning of the filter element(s) without the need for their replacement, is also needed.

SUMMARY OF THE INVENTION

In light of the aforementioned problems associated with the prior systems and methods, it is an object of the present invention to provide a Multiple Parallel Layer Filter and Filtration Method. The device and method should provide superlative filtration in macro,
5 micro and nano ranges for a variety of fluids. The device should use filtration elements that are relatively low cost, yet provide the significant advantage of being able to be flushed periodically to remove captured solids. The device should employ an arrangement of filter elements wherein the filtration axis of the filters is perpendicular to the flow axis of the collecting housing. The device and method should further provide a way for adjusting filter
10 to capture different sizes of solids, depending upon the particular user adjustment.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages, may best be understood by reference to the following description, taken in connection with the accompanying drawings, of which:

Figure 1 is cutaway side view of the multiple layer parallel filter of the present invention;

Figure 2 is a perspective view of a filter stack of the filter of Figure 1;

Figure 3 is perspective view of the filtering assembly of the invention of Figures 1 and 2; and

Figures 4A and 4B are graphs depicting the performance characteristics of a filter of the type of the present invention.

DETAILED DESCRIPTION
OF THE PREFERRED EMBODIMENTS

The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventors of carrying out their invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the generic principles of the present invention have been defined herein specifically to provide a Multiple Parallel Layer Filter and Filtration Method.

The present invention can best be understood by initial consideration of Figure 1. Figure 1 is cutaway side view of a preferred embodiment of the multiple layer parallel filter 10 of the present invention. The filter 10 is an assembly contained within a housing 12 is enclosed by a lid 14 attachable to its upper opening to form a recipient chamber 32 within it. The recipient chamber 32 is in fluid communication with an inlet port 16 and a refuse port 24.

The inlet port 16 allows fluid, such as water to flow through it into the recipient chamber 32 from an inlet duct 18 attached thereto. The inlet duct 18 is a source of non-filtered fluid expected to contained solid matter entrained within it. In a non-depicted version, the inlet duct 18 and inlet port 16 are located excentrically relative to the central axis of the housing 12 – such a shape creates a swirling effect for fluid entering the housing 12 which aids in the separation of particulates from the fluid via centrifugal force.

The refuse port 24 allows the waste fluid effluent to exit the recipient chamber 32 and exit through a refuse duct 26. Furthermore, the filter can be back-flushed periodically to remove captured solid matter from the filter media.

Contained within the housing 12 is a novel filter assembly. The assembly is a
5 stack of filter layers 34 that each have a hole in their middle, through which a collector housing 20 passes. A variety of materials may be employed for the layers 34, but it has been demonstrated that “optical” precision filter elements (i.e. very high precision) demonstrate extremely suitable results. The filter layers 34 are held on the collector housing 20 by a compression plate 36. The compression plate or bell 36 may be of a similar planar
10 configuration to the filter layers 34, although it may be slightly larger or smaller in diameter in order to avoid any centering issues. In the depicted version, however, the plate 36 actually has a concave bell shape that causes the upper rim of the plate 36 to be the point of contact between the plate 36 and the filter layers 34 – this design has been demonstrated as particularly successful because it creates an outer boundary filtration layer, with an inner core
15 the causes less of a flow restriction. There may be a corresponding rim structure protruding from the lid 14, to aid in creating this boundary layer of filtration. The compression bell 36 is pressed against the stack of filter layers 34 by an adjustment device 38, such as a conventional nut, bolt or screw. It should be apparent from the arrangement of the elements in the filter assembly that if the adjustment device 38 is tightened or loosened, it will squeeze or release
20 squeezing force against the stack of filter layers 34. By adding compression to the stack of layers 34 (by tightening the adjustment device 38), the filter stack height $H(f)$ will be reduced and the gap between each layer 34 will be reduced. Conversely, if compression is reduced by

loosening the adjustment device 38, the filter stack height $H(f)$ will increase due to the gap between each layer 34 increasing.

As will be discussed more fully in connection with Figures 2 and 3, as fluid passes from the recipient chamber 32 and through the filter layers 34 (horizontally) from the outside of the stack of layers 34 and inward to the collector chamber 30, the fluid will be filtered of the solid matter previously entrained in it, and it will exit the collector chamber 30 through the discharge port 20 and discharge duct 22. Now turning to Figure 2, we can continue to examine this novel invention.

Figure 2 is a perspective view of a filter stack 47 of the filter 10 of Figure 1. The filter layers 34 are shown to be circular rings having an outer periphery 44 and an inner periphery 42 surrounding an inner aperture 40. In other versions of the filter 10, other shapes may be employed for the filter layers 34 (e.g. a square outer periphery and a circular inner periphery, etc.). Where the term “ring-shaped” is used herein, it is intended to describe a structure having an outer periphery and at least one centralized aperture – it is explicitly intended to limit the description to only circular structures.

What is unique about this design is the filtration approach that this invention takes. The fluid flows inward from the outer periphery 44 towards the inner periphery 42 in a direction that is perpendicular 52 to the central axis 48 defined by the collector housing (see Figure 1). Once inside the collector housing (see Figure 1), the fluid (now filtered) will follow a parallel flow path 54 (relative to the central axis 48). This approach is very suitable for removing sand from water. The filter layers 34 may be made from a variety of materials

and may exhibit a variety of stiffness or rigidity characteristics, depending upon the fluid being filtered and the expected solids that are wished to be removed.

A very unique aspect of this invention is that the spacing 46 or gap between the layers 34 can be adjusted by tightening or loosening the compression plate or compression bell (see Figure 1). As the spacing 46 is decreased, smaller and smaller-sized solids will be captured as the fluid flows between the layers 34. When the user desires to remove captured solids from the filter stack 47, such as for routine maintenance, it is a simple matter to reduce the compression on the stack 47 by loosening the adjustment device (see Figure 1) so that the foreign bodies can be back-flushed out through the refuse port (see Figure 1). Turning, now
10 to Figure 3, we can review additional detail about other elements of the invention.

Figure 3 is perspective view of the filtering assembly 60 of the invention of Figures 1 and 2. The assembly 60 is a combination of the collector housing 28, the filter layers 34, the compression plate (or bell) 36 and the adjustment device 38. The collector housing 28 is defined by an open top end 64 that connects the housing 28 to the discharge port
15 20. The housing 28 has a bottom end 62 that has a threaded portion 66 adjacent to it (either external or internal threads). The bottom end 62 is sealed to prevent fluid flow into it. The inner apertures 40 are sized so that the filter layers 34 can be slipped over the collector housing 28. The collector housing 28 further has a plurality of weep apertures 68 dispersed across its wall that allow filtered fluid to pass from the exterior of the collector housing 28
20 and into the collector chamber 30. The apertures 68 can be slot-shaped as shown, or be other shapes, as desired.

Here, the collector housing 28 and filter layers 34 are shown here to both have circular shapes; it should be understood neither of these elements are confined to these shapes – different shapes might be employed for a variety of applications.

The stack of layers 34 is bounded on its bottom by a compression bell 36; there may be a fixed compression bell at the top of the stack of layers 34 as well. The filter layers 34 and plate 36 are held on the compression housing by an adjustment device 38 that is threadedly engaged with the threaded portion of the collector housing 28. From this drawing it should be apparent that turning the adjustment device 38 will cause the device 38 to travel up and down the threaded portion 66 of the housing 28, and will in turn increase or decrease the compression on the stack of filter layers 34. Finally turning to Figures 4A and 4B, we can understand the implications of this novel design.

Figures 4A and 4B are graphs depicting the performance characteristics of a filter of the type of the present invention. Figure 4A represents that as filter stack height $H(f)$ increases, the minimum size of the particles trapped in the filter will increase; as the height $H(f)$ is decreased, smaller particles will be trapped. Similarly, as shown in Figure 4B, as compressive force is increased on the filter stack, purity of the discharged (filtered) fluid will be increased as well.

Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that,

within the scope of the appended claims, the invention may be practiced other than as specifically described herein.